

DOCUMENT RESUME

ED 161 448

IR 006 601

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TITLE The Role of Formative Research in Evaluating Specific Curriculum-Based Television Programs at the Primary Level.
PUB DATE Jun 78
NOTE 16p.; Paper presented at the First Congress on Education (Toronto, Canada, June 1978)
EDRS PRICE MF-\$0.83 HC-\$1.67 Plus Postage.
DESCRIPTORS Curriculum Development; *Educational Research; *Educational Television; *Elementary School Mathematics; Evaluation; *Formative Evaluation; *Instructional Design

ABSTRACT

Formative research of Math Patrol, curriculum-based television program in mathematics at the primary level, was carried out as part of a research and evaluation project at the Ontario Educational Communications Authority (OECA). The series, which utilizes plasticene animations, consists of 15-minute magazine format programs which introduce and reinforce fundamental mathematical concepts from the grade 2 curriculum. Designed to appeal to the imagination of young children, the story line is based on assignments given to super-sleuth Sidney by Mr. Big, a world champion puzzle solver and founder of an international organization to solve math problems. Evaluation showed that this program can be an effective learning tool both in increasing the understanding of math at this level and providing a high degree of motivation for the target audience. This formative research also resulted in a significant cost savings and changed potentially confusing portions of the series into strong pedagogical tools. (Author/VT)

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The Role of Formative Research
in Evaluating Specific
Curriculum-Based Television Programs
at the Primary Level

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Paper presented to the First Congress on Education; sponsored by the Canadian School Trustees' Association, June, 1978, in Toronto, Canada, Seminar on Educational Research, Information and Dissemination.

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IP006601

There is little doubt that television today is a popular and integral part of our lives. Recent research indicated that over 98% of Canadian homes have at least one television set. The average viewing time for Canadian children is 21.2 hours per week, or over 3 hours per day. (Bureau of Broadcast Measurement, 1977.)

In recent years, an attempt to use this influence in a socially and educationally beneficial way has been made. More and more, televised instruction has become a part of the regular classroom curriculum. As better programming has become available, television has moved from being considered only as a convenient "babysitter" to being perceived, by many educators, as a useful tool for educational enrichment.

There are many arguments one could make for the benefits of television in the classroom. Among these are the children's enjoyment of the medium, their motivation to view, the large amount of time and effort spent on one program when compared to the necessarily limited preparation time of the topic by a teacher, the ability to use the program repeatedly, and the use of television to provide stimulus variation to the regular curriculum. Television in the classroom can be used to recapture attention or stimulate new thoughts by presenting a novel or different direction for a traditional subject.

However, all of these benefits are meaningless if televised instruction is not fulfilling its major goal; to teach.

There have been a number of attempts made in recent years to evaluate educational television in terms of its instructional effectiveness. In 1975, researchers at The California Institute for Communication Research reviewed over 400 studies comparing live and televised teaching of virtually all subjects at all grades and levels. Extensive statistical analysis revealed no general pattern of differences between the two methods. Rather, the success or failure of television as a part of the course of study appears to depend upon the nature of the course itself. (Chu and Shramm, 1975). Although TV will never replace the classroom teacher, when it is integrated with the regular course content, the role of television in the classroom needs no further justification.

It is clear that television can be extremely effective in disseminating specific factual information in an appealing manner. At OECA, one of the primary functions of the Department of Research and Planning is to assist the production staff in attaining this goal. A further function is to assess the success of the product, in order to improve future programs. These concerns typically are differentiated by the terms: formative research or formative evaluation.

It is possible to draw a clear distinction between formative research and formative evaluation. In the latter, a specific product (for example, a program or segment of a program) is evaluated on a number of discrete dimensions. Typically, any conclusions drawn from this type of research are applicable only to the product being tested.

In contrast, formative research may be applied to general concepts or problems. The conclusions drawn from this theoretical-based research should be able to be applied to a variety of similar projects.

For example, rather than reformulating or redefining educational objectives for each new program, a series of potential objectives would be clearly stated, with well-documented previous research studies to draw from.

Thus, rather than beginning with a project and examining specific questions related only to that project, formative research attempts to begin with theory and relate it to the project. In this way, already researched practice may be transformed into improved practice.

Formative research for educational television therefore serves two purposes. First, a body of theoretical knowledge is built up which may be drawn upon at a later date. Second, current research projects may build upon theoretical data to improve present methodology.

In contrast, formative (or summative) evaluation is typically designed to examine a specific program or segment of a program. Often, a pilot of a proposed series is evaluated in order to provide information about it's strength and weaknesses prior to the production of the remainder of the series. Any changes arising out of the findings of the research may then be incorporated into the series.

Formative evaluation is generally designed with three major objectives. First, the educational effectiveness of the program is scrutinized. The major question here is "is the program teaching what it is supposed to?". This is examined by testing the children's knowledge or increase in knowledge of the content of the program.

Second, the appeal of the program is evaluated. No matter how much instructional relevance the program has, if the target audience do not like it, they will not watch it or learn from it. Thus, the appeal of the concept, the format, the characters, the music and many other components for the target audience are examined.

A final major element of formative research or evaluation is the manner of classroom utilization. The majority of the in-class television programs at OECA are only one component of a total learning system, usually including some form of print material such as a Teachers' Guide. The way the program fits into the learning system to produce the most effective classroom utilization is thus of great importance.

As an example of one formative research project at the OECA, I will describe part of the research and evaluation procedure carried out on a specific curriculum-based television program at the primary level: Math Patrol.

Math Patrol is a series of 15 minute magazine format television programs designed to help the Primary level child develop an understanding of some of the fundamental concepts of math. Each episode consists of a number of segments designed to introduce and reinforce one aspect of the grade 2 mathematics curriculum. The test episode was concerned with "Double-Digit Subtraction Without Carrying."

The title Math Patrol refers to an international organization set up to solve math problems. It was founded by Mr. Big, world champion puzzle solver. Mr. Big has gone into seclusion so the audience never sees him, and most of his undercover work is done by his assistant, Sydney. Although Sydney is a nice guy, he has an unusual way of approaching Math. For instance, he learned his fractions by tearing phone books in half. Mr. Big insisted that Sydney work in disguise and the only disguise that the costume rental agency had at the time was a kangaroo outfit. The children are not expected to believe in the kangaroo as a real character. They are in on the joke that the disguise is so ineffective that it is comical.

The programs in the series revolve around the assignments given to Sydney, the super-sleuth. You can tell he's a super-sleuth because of his hat, trench coat and furtive glances. Sydney also has a kangaroo pouch which serves as a storage compartment for everything from food to a telephone, etc. He is soft-spoken but a bit of a grumbler when things don't go his way and especially when he is given assignments which he believes fall short of his potential.

Interspersed in the story line are a number of other segments which contribute to the viewer's understanding of the math concepts.

Each episode concludes with a puzzle Mr. Big gives Sydney to solve for which no solution is provided. The viewer is asked to complete this problem in the classroom.

The main story line in the test episode is concerned with Sydney's capture of "His Highness, Lord Minus" who makes objects disappear (through subtraction). Sydney finally captures Lord Minus, then frees him. The final shot is of Sydney standing on a street corner while all of the objects around him disappear.

The main objectives of the Math Patrol series, as summarized by the producer, are "to introduce important math topics in interesting ways to primary level students" and "to be instrumental in developing positive attitudes towards math by helping the child understand different math processes and by improving his/her mathematical ability." (A prior formative research study had resulted in substantial changes to the pilot program.)

The purpose of this research project was to determine whether the program is meeting these goals. Specifically, this research aimed to assess the degree of receptivity and appeal of Math Patrol for the target audience and their teachers, and to discern whether understanding of the basic math concepts is achieved by viewing.

The program selected for test purposes was the sixth episode, "Subtraction II", of the ten episode Math Patrol II series. This episode was chosen to be consistent with the mid-year testing date.

Three grade 2 classes were from essentially average-income areas and one from a lower-income, ethnically mixed neighbourhood, with a total of 107 grade 2 students, evenly divided between sexes. The teachers indicated that all classes had average abilities in math. The math concept dealt with in the test episode, double-digit subtraction without regrouping, had only been introduced briefly in one of the classes prior to viewing.

All 107 children completed a short pre-test questionnaire which included the specific math problems introduced in the test episode. After viewing, a detailed post-test was administered. Each question was read aloud twice by a researcher in order to dispel any comprehension problems. The questions themselves were multiple-choice requiring no word writing to be done.

In addition to the written tests, trained researchers systematically observed the behaviour of a randomly selected sample of the children during the viewing. To avoid the possibility of reactions generated by language difficulties, the first language of all the children being observed was English. A total of 30 children (15 boys and 15 girls) were observed without the subjects' knowledge. An observation sheet was developed to record the behavioural trends during viewing. A pre-determined series of behaviours were delineated to facilitate the observation of 3 students at a time by a single observer. The behaviours viewed included level of attention, types of interactions and other overt behaviours.

The viewing environments were informal in character; with two sessions taking place in the classroom and two in the school library. The subjects were seated on the floor, with the observers unobtrusively to one side.

Testing results indicated that the program would successfully teach math concepts.

Those math problems appearing in "Subtraction II" were included in the short pre-test, and repeated at the mid-point of the written post-test. A final math test was included after the post-test. To eliminate the possibility of correct answers given solely through memory, each example in this final test was matched in concept with one in the pre-test but with slightly varying numbers.

In the pre-test to post-test comparison of these math problems, significant changes were recorded in four of the six sets. These included a variety of problems from double-digit minus single-digit ($15-7=$) to double-digit minus double-digit ($47-23=$). All but one of those math problems in which a significant change was recorded are at a level better than $p < .01$.

The two problems in which no significant change was observed were the last in the series; these had a higher proportion of "no answer" (regarded as "wrong"), possibly attributable to time restrictions imposed on completion of the test.

In comparing the pre-test to the final test (which had problems matched in concept but with slightly varying numbers), five of the six sets of problems resulted in a significant change.

Although, as stated above, there was a significant positive change in successfully completing the pre- to post-test math examples, further data indicated that the understanding of the concept of subtraction in its verbal form was mixed.

As discussed earlier, a second major objective of formative research is to determine appeal of curriculum-based programs.

In order to examine this, specific questions were asked on the questionnaire and observations were made during viewing to determine the appeal of Math Patrol for the target audience.

Given a choice of all segments, the children indicated their preferred segment. As might be expected, there was greater hesitancy in the selection of the least favorite segment. Almost one-half said "do not know."

The overall reaction to the main storyline and characters was also extremely positive.

As an additional measure of appeal of Math Patrol, the following two questions were posed: "Did you like Math Patrol?" and "Would you watch it at home?". The responses to both questions were overwhelmingly positive. As an added indication of appeal they were asked if they "would tell a friend to watch it?". Almost 2/3 said yes. 19% said no and the remaining were not sure. There was no significant difference by school or sex in the responses to the above three questions.

The attention patterns of 30 children were observed segment by segment during the viewing of "Subtraction II." Both sexes showed quite similar attention patterns. Attention was consistently high throughout the program with one obvious digression.

Little motor response other than smiles and laughter related to the program and pointing activity towards the set due to enthusiasm during the opening animation sequence was observed.

Interaction of the subjects with each other and interaction directed to the program material was also recorded. Little activity of this nature occurred during the first half of the program, but increased noticeably during the later segments. During the one specific scene, this interaction was program-related, while during a second, interaction was directed away from Math Patrol.

Teachers make the crucial decisions concerning regular in-class use of educational programming. Therefore, any series must have a high degree of acceptability for them. In order to assess this, the class teachers present during the test episode were requested to fill out a rating sheet while viewing, indicating their personal appraisal of the value of each segment. The overall response was very favorable.

They rated all segments; two were rated above average (3 - or more on a 5-point scale) with the cartoon introduction rated highest and the initial scene close behind. Only two segments were rated as average or less (3 or less).

The teachers were also asked to comment on the degree of difficulty of the math content for their respective classes. All believed that such a program would benefit the average student and, in addition, the slower math learner was noted as a potential beneficiary.

All six teachers thought that their students would like to watch Math Patrol on a regular basis.

Math Patrol has proven to be an effective learning tool in meeting the objective of increasing the understanding of math at the grade 2 level. A significant change occurred between the pre-test and the post-test on specific math problems. Additional evidence that this was a genuine improvement was shown in the final test. These results were particularly striking in light of the following facts: math is not highly rated as a school subject by these children, and there was no systematic introduction of the concept of double-digit subtraction prior to viewing.

Math Patrol was found to provide a high degree of motivation for the target audience. That it was well received is shown by: the consistent attention, the results of the written questions and the desire to see more Math Patrol episodes. One must bear in mind that the demand characteristics of the testing situation might result in such findings. However, informal discussion with the children after viewing indicated a high degree of enthusiasm. For example, many wanted to join "The Math Patrol" or write to Sydney, the main character.

On the basis of these results, specific recommendations were made to the production staff on revisions to both the format and content.

Six months later, while Math Patrol series for grade 3 was still in production additional formative research was conducted. The producer has expressed some reservations about the effectiveness, the appeal and the visibility of essential detail of new plasticene animation segments. This production technique has not been used to date. Since the program was in its final editing stages, severe time constraints were imposed upon the research.

Testing took place at four schools, using one grade three class at each; with a total of 97 children. The test instruments included both written questionnaires and observations.

The plasticene animation which was tested was found to be an appealing and effective visual form to illustrate math concepts for the specified target audience. Those segments with a stronger emphasis on character (human or animal) humour and music had a higher degree of appeal for the children.

On the basis of these findings, the recommendation was made that those plasticene animation segments produced to date could safely be incorporated into the Math Patrol programs in final production. Certain suggestions were made concerning the format and content of future segments. Among these were that plasticene segments should have a strong emphasis on human or animal characters, humour and music. They should deal principally with concepts that can be illustrated by gross one-step physical manipulation rather than multi-step combinations of movements. In addition, it was recommended that special attention be paid to the visibility of such segments through the use of high contrast and bright colours and a high proportion of close-up shots.

It was pointed out that this formative research resulted in a significant cost savings and changed potentially confusing portions of the series into strong pedagogical tools.

The above has been one specific example of the way in which formative research and evaluation is used at OECA in evaluating specific curriculum-based television programs at the Primary Level. As indicated earlier, a number of quite different designs may be used, depending on the areas to be evaluated.

In summary, we feel very strongly that television has a role in the classroom today. Our main function, in formative research and evaluation, is to attempt to make that role as successful and useful to the educator as possible. This will only be accomplished by continuing in our efforts to assess, and thereby, hopefully, improve our programming.

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